

RESEARCH ARTICLE

PRODUCTION AND MARKETING ECONOMICS OF OFF-SEASON TOMATO IN KASKI DISTRICT, NEPAL

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ABSTRACT

Tomato cultivation is one of the most profitable and offers farmers a viable opportunity to enhance their socio-economic status. A study was conducted in order to access production economics of tomato, different factors affecting economic viability using linear regression and find out the price spread, producers share in tomato marketing. The data was collected from 50 farmers involved in tomato farming in Kaski district through semi-structured interview schedule. Along with the farmers 5 wholesalers and 10 retailers were also interviewed in the study area. The average input cost in tomato cultivation was found to be Rs. 870343.8 having total revenue of Rs.5413378.4 per hectare respectively in one season. The overall B/C ratio was found to be 6.21, which implies that tomato farming in the study area in very profitable farm business. Reception of subsidy and total land under cultivation was found significantly affecting economic viability of tomato production where as other factors was not significant and Producer share for channel producer to wholesaler to retailer to consumer was 60.98% whereas price spread was 50.7 and in channel producer to retailer to consumer was 69.17%, price spread 37. The major production problem was found to be climate change while the major marketing problem are lack of market information and price fluctuation. Almost all farmers were fully satisfied with tomato farming; it is highly profitable occupation in case of Kaski district and can be commercialized in large scale.

KEYWORDS

Price spread, viability, market information, socio-economic, producer share

1. INTRODUCTION

Agriculture plays a significant role in the Nepalese economy, providing sustenance, employment, and contributing to both economic and social transformation. The combined sectors of agriculture, forestry, and fisheries accounted for 25.8 percent of the GDP, and this contribution was projected to grow despite the global impact of the Covid-19 pandemic (MoF 2022). Nepal's cultivated land encompassed 309,100 hectares, representing 21 percent of the country's total land area (MoALD, 2023). Tomato is grown from subsistence to commercial scale; and from the east to far west and Terai to mid hill and mountain regions in Nepal (Babu et al., 2016).

Tomato is second most important vegetable after cauliflower in terms of area of land used for cultivation, and volume of production in Nepal. Tomatoes are grown across approximately 22,600 hectares of land in Nepal, yielding an annual tomato production of around 432,000 metric tons (MoALD, 2023). Total world tomato production for both processing and fresh consumption in 2021 amounted to just over 189.1 million metric tonnes. China is the world's largest tomato producer with approximately 60 million tonnes (Food, 2022).

Tomato cultivation is one of the most profitable and feasible crops to improve farmers' socio-economic conditions (Pokhrel, 2021). Its

cultivation plays a vital role in enhancing the productivity and income of farmers in vegetable farming (Khanal, 2019). In 1996, tunnel technology was introduced by the regional agriculture research station in Lumle, Nepal. Subsequently, the Nepalese government, in its efforts to promote commercial vegetable farming, introduced tunnel technology for tomato production. They provided training to facilitate the adoption of this technology (Diwakar et al., 2021). Kaski district in Nepal offers excellent potential for large-scale open-field tomato cultivation during the primary season and offseason cultivation under plastic houses. This is due to its convenient road access for marketing, proximity to the vegetable wholesale market in Pokhara, and increased demand for tomatoes from various tourist hotels during the off-season, allowing for potentially higher prices.

Inadequate research and studies on vegetable farming production and marketing have restricted the progress of vegetable sector (Ghimire et al., 2018). Growing health awareness and consumer purchasing power in Nepal drive an increased demand for fresh vegetables. However, the country remains a net importer, largely relying on neighboring India for its vegetable supply (CASA, 2020). Despite of many research in tomato farming, the practical findings are only limited in urban areas. In terms of marketing, market imperfections in Nepal are attributed to factors such as limited market accessibility, low output prices, absence of storage facilities, insufficient draft power, subpar transportation infrastructure,

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and inadequate government assistance in price regulation. Furthermore, farmers receive less price information compared to traders (Sharma, 2019). The key challenges in tomato farming in Nepal include the lack of high-quality inputs and improved varieties, limited access to modern farming equipment and technical knowledge, market price fluctuations, and inadequate access to market information (Rai et al., 2019)

Despite the active promotion and widespread adoption of different technology, there is a conspicuous absence of concrete evidence to ascertain whether it has proven to be beneficial for smallholder farmers or not in vegetable farming (Diwakar et al., 2021) and most of the vegetable farms are comprised with small land holdings i.e. less than one hectare. Since there is a lack of comprehensive research examining the cost-effectiveness, awareness, and marketing strategies at farm level, the main objectives of this study are i) to access the production characteristics and economic viability of tomato production, ii) to examine marketing channels, producers share and price spread in tomato marketing of study area and iii) to identify the major constraints in the production and marketing of tomato.

2. MATERIALS AND METHOD

2.1 Research Design

In order to conduct the research and attain the intended outcomes, it is crucial to align the study methodology with an appropriate strategy that facilitates decision-making and assists in addressing the research objectives of the thesis. Quantitative research was conducted and both descriptive statistics and financial analysis are employed to investigate the research objectives.

2.2 Study Area

The study was conducted within Kaski district of Nepal which is situated within latitude 28°18'19.08" north, longitude 84°04'37.20" east. It was chosen due to prevalence of off-season tomato production specifically tunnel tomato farming, among the majority of the farmers in the area. Additionally, its designation as a vegetable super zone by PMAMP indicates significant potential for enhancing vegetable productivity and fostering commercialization. Moreover, the selection of Pokhara Metropolitan City and Machhapuchhre Rural Municipality was done primarily based on the abundance of tomato cultivation areas, coupled with convenient access to market information in Pokhara Metropolitan City. 50 Farmers were selected using simple random sampling, 30 farmers were from Pokhara city and 20 from Machhapuchhre along with 10 Retailers and 5 Wholesalers.

2.3 Data Collection and Analysis

Primary data was collected from the tomato growers, wholesalers and retailers using pre-tested semi-structured questionnaire which was prepared in the English language and questions were asked in the Nepali language. The interview questions were prepared following the objectives of the study. The collected data underwent inputting, tabulation, and analysis through analysis software. For this research, the data was analyzed using both SPSS (Statistical Package for Social Science) version 25 and Microsoft Excel. Subsequently, the data is analyzed by employing both financial and statistical methods. The study has embraced a descriptive research approach.

We used various supplementary resources, such as academic journals, prior research, pertinent websites, publications from related organizations, and books authored by different writers, to acquire a comprehensive grasp of the subject.

2.4 Financial Analysis

This section encompasses a comprehensive examination of several key aspects related to the study, including the analysis of production costs, the benefit-cost ratio (B:C ratio), gross returns, net returns, market margins, and the proportion of the consumer's rupee that the producer retains. It is within this section that these vital components are thoroughly assessed and analyzed to gain a deeper understanding of the economic aspects and financial dynamics involved in the subject matter of the research.

2.4.1 Total Cost

It is the total cost involved in the production of certain output or product (Samuelson & Nordhaus, 2009) and is calculated as:

$$TC = FC + VC$$

Where TC = Total cost, FC = Fix cost, VC = Variable cost

Fix cost indicates the summation of the cost incurred in all fixed items and variable cost means the summation of the cost incurred in all the variable items. But only Variable cost is accounted in analysis of this tomato production research.

2.4.2 Gross Return

It is the total revenue obtained by selling the produced item (Samuelson and Nordhaus, 2009) which is calculated as follows:

$$GR = Q * P \text{ Where } GR = \text{Gross Revenue}$$

Q = Total quantity of product marketed and P = per unit price of the product

2.4.3 Net Return

Net return is the profit obtained i.e. the difference between gross return and cost of production which is calculated as:

$$NR = GR - TC$$

Where NR = Net return, GR = Gross return, TC = Total cost of production

2.4.4 Benefit-Cost (B: C) Analysis

The benefit-cost analysis will be done after the calculation of the total variables cost and gross return from the vegetable cultivation. It is calculated as;

$$B/C \text{ ratio} = \text{gross return} / \text{total variable cost}$$

Where Gross return can be calculated as;

$$\text{Gross return} = \text{Total quantity (Kg)} * \text{Price per Kg (Rs)}$$

2.4.5 Marketing Margin

Marketing Margin (MM) is the difference between the price paid by the consumers and the price received by the farmers and will be calculated by subtracting farm-gate prices from retailer prices.

$$MM = \text{Retailer Price} - \text{Farm gate Price}$$

2.4.6 Producer's Share

Producers' share is the price received by the farmer expressed as a percentage of the retail price, that is, the price paid by the consumers (FAO).

It can be calculated by the following formula.

$$PS = (Pf / Pr) \times 100$$

Where, Pf = Producer's price (farm gate price), Pr = Retailer's price and Ps = Producer's share

2.4.7 Price Spread

Price spread refers to the difference between price paid by the consumer and price received by the producer for an equivalent quantity of the farm product. This price spread consists the proportion of consumer's rupee that is shared by the market functionaries as their margin including the marketing cost and charges. It gives fair idea about relative efficiency of various marketing system and channels.

$$\text{Price Spread} = \frac{\text{Price paid by consumer} - \text{Price received by producer}}{\text{Price paid by consumer}}$$

2.4.8 Marketing Channel

The marketing channel was drawn based on the information obtained from the producer level to the consumer level. All linkage and coordination among all levels i.e. input supplier, grower, collector, retailer, and final consumer were analyzed for the marketing channel.

2.4.9 Indexing Production and Marketing Problems

Scaling method gives the way and attitude of the respondents towards propositions. Farmers opinion on the importance given to the different production and marketing constraints/problems were analyzed by using 5 point scale of constraint/problems comprising the least serious, a little

bit, moderate, serious and the most serious by using 1,2,3,4, and 5, respectively.

The index of importance was computed by using the following formula:

$$I_{imp} = \frac{\sum (S_i \cdot f_i)}{N}$$

Where,

I_{imp} = Index of importance, \sum = Summation, S_i = Scale value, f_i = Frequency of importance given by the respondents and N = Total numbers of respondents

3. RESULTS AND DISCUSSION

3.1 Institutional Information

3.1.1 Association of Farmers with Cooperatives

Most of the people were involved in cooperatives while few of them were not. 59 percent were in association with cooperatives and 41 percent were not.

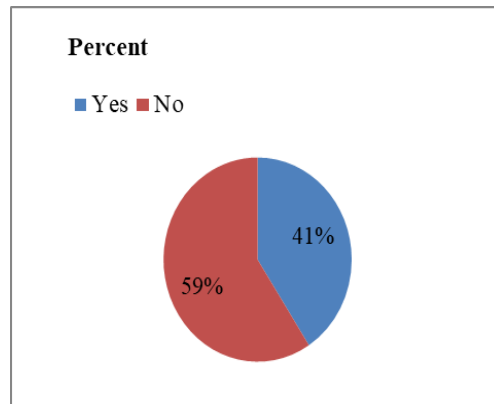


Figure 1: Association with Cooperatives

3.1.2 Association with Farmer Groups

In our study, only 30.6 percent of the farmers were involved in farmer groups while rests of the 69.4 percent were not involved in farmer groups.

3.2 Subsidy Received

High portion of farmers had received subsidy which is also found significant in increasing tomato production in this study.

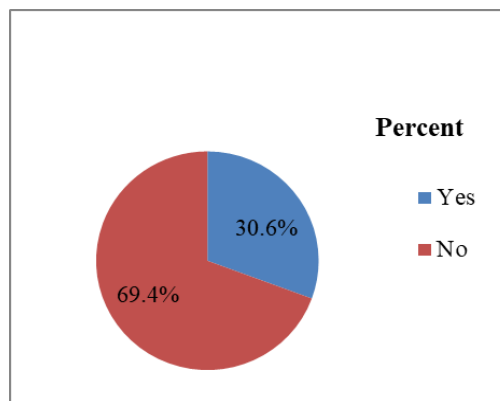


Figure 2: Association of farmers with Farmer Groups

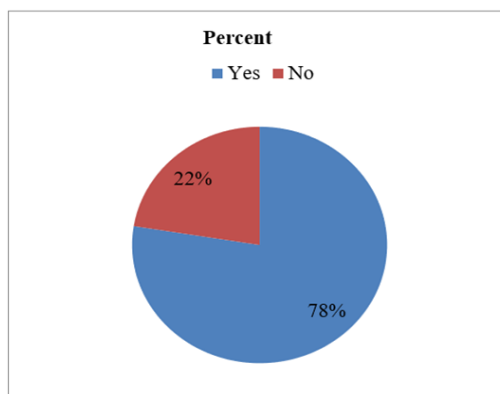


Figure 3: Subsidy Received

3.3 Training Received

Only 41 percent of farmers received training and 59 percent had not received any training on tomato farming.

3.4 Cost of Production

Cost of returns referred to the outlay of funds for the procurement of necessary inputs and labor employed. It is the most important factor in the

cultivation of agricultural crops, which influences the profitability of the produce and also shows input use efficiency of the farmers. Cultivation of tomato incur various type of cost, since it uses various kinds of input in terms of labor, manure, fertilizer, seed, irrigation, pesticides etc. For the analysis of cost of production, only variable costs were taken into account. The average total production was found out to be 60.32 tonnes per hectare. The result showed that the cost of production per ha was NRs.870343.8. with production per kg Rs14/kg. Similarly, average total return was found out to be NRs.5413378.4.

Table 1: Cost of Production

Variables	Cost	Percentage
Fertilizers	59440.45	6.79
FYM	209402.97	24.05
Fungicides	43435.65	4.96
Insecticides	69982.57	8.04
Micro nutrient	29951.70	3.44
Labor	79557.053	9.14
Seed and Seedlings	61445.8	7.05
Land Rent	69999	8.04
Transport	43327.83	4.97
Market Fee	28661.58	3.31
Repair	121035	13.90
Vitamins and Hormones	44941.53	5.15
Irrigation	8891	1.02
Total	870343.8	100

Table 2: Cost of production, Gross return, Net return and B/C ratio per hectare

Cost of production	Rs.870343.8
Total production	60.32 tonnes
Production cost/kg	Rs14.83
Gross return	Rs.5413378.4
Net return	4543034.6
B/C ratio	6.21

The study found B:C to be 6.21 that revealed the tomato cultivation is the profitable enterprise in the study area. A study conducted by NARC, 2016, (Babu et al., 2016) had shown that benefit cost for the off season and main season (open field) in mid hills was 1.5. In comparison to the NARC findings, b/c ratio from this study is too high; this may be due to extreme increase in selling price of tomato during study period. Tomato price was at its peak resulting high benefit for farmers. Total cost includes Productivity resources and labor cost.

3.5 Influence of Different Factors on B/C Ratio

Table 3 shows that the model summary of linear regression model where the B/C ratio of the tomato is dependent variable and Farm characteristics and other institutional characteristics of farmers are the independent variables.

Table 3: Regression coefficient and t-values

		B	Std. Error	t	Sig
1	Constant	5.175	2.590	1.999	.053
2	Subsidy Received	1.363	0.560	2.432	0.020*
3	Total Land Cultivated	0.096	0.042	2.305	0.027*
4	Training Received	1.042	0.717	1.453	0.155
5	Association with Farmer groups	0.066	0.601	0.110	0.913
6	Association with Cooperatives	-0.044	0.647	-0.069	0.946
7	Animal productivity	-0.067	0.206	-0.324	0.748

Dependent variable: BC ratio

*= Significant at 5percent level of significance

	F-value	3.088
	R square	0.507
	Adjusted R square	0.343

The value of R square was found 0.507 which indicates the 50.7 percent variation of B/C ratio is explained by: subsidy received, total land cultivated, training received, association with farmer groups, association with cooperatives and animal productivity.

Coefficient for subsidy received and total land cultivated were found to be positive and significant at 5percent level of significance, It means that the subsidy received and total land cultivated are positively related to the b/c ratio. The estimated coefficient of subsidy received (1.363) indicated that the each additional unit in subsidy reception, average expected increase in B/C ratio is 1.363 times, assuming that the other variables are constant, similarly the coefficient of the total land cultivated was found 0.096 which indicates that, if there was unit increase in total land cultivated then B/C ratio would have been increased by 0.096 times.

All the explanatory variables had positive coefficients except association with cooperatives (-0.044) and animal productivity (-0.067). The

contribution of these variables was negative and result was not significant. There is no effect of these variables on B/C ratio. Likewise, the contribution of the variables –training received and association with farmer groups were positive but not significant.

3.6 Price Behavior of Tomato in Market

The price of tomatoes typically exhibits significant variations, influenced by factors like seasonality, daily changes, and even hourly fluctuations. These variations are primarily driven by uncertainties in the supply and demand dynamics (Chaudhary, 2010). Table 4 provides descriptive statistics for the monthly wholesale tomato prices at the Pokhara Wholesale Market in Pokhara, covering a one-year period from Shrawan 2079 to Shrawan 2080. Tomatoes are broadly classified into two categories based on size: small and large. It is noteworthy that there is substantial price variation observed in both types of tomatoes.

Table 4: Average Wholesale Price of tomato in Kaski				
Tomato Type	Mean	Standard deviation	Maximum	Minimum
Tomato small	56.57	21.83	117.52	35.21
Tomato Big	67.78	24.16	127	38.21

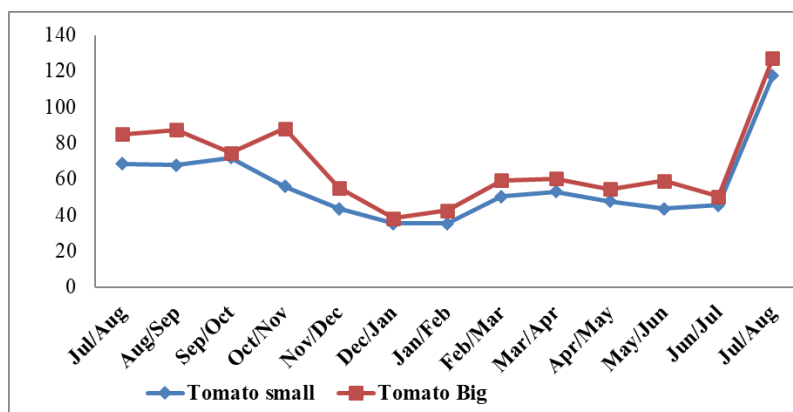


Figure 5: Monthly Wholesale prices of tomato in Pokhara Wholesale Vegetable Market Source- Pokhara Wholesale Market Development Board (2023)

The figure illustrates the pattern of price fluctuations. It is evident that the wholesale prices for both types of tomatoes peak in the month of Jul/Aug. Subsequently, prices begin to decline and then experience a surge in Oct/Nov. Notably, the larger variety of tomatoes consistently maintains a higher price compared to the smaller ones. Post-Nov, tomato prices experience a sharp drop until the month of Dec/Jan, after which they gradually rise. Eventually, prices reach their peak once more in the month of Jul/Aug, with a significant difference, marking the highest prices recorded.

3.7 Marketing Channels

The marketing channels for vegetables vary from commodity to commodity, producer to producer, lot to lot and time to time. In Nepal, agricultural commodities move from farmer’s field to consumers through several channels. Here are the results of survey showing different market

channels used by tomato farmers. It is found that most of the farmers use the channel one i.e. Producers as a wholesalers –retailers–consumers. In contrast (Pokhrel, 2021) in his study in Kathmandu found channel (producer-wholesaler-retailer-consumer) as a most used in channel. In this study the survey was conducted in the place where commercial cultivation of tomato was done thus, the greater portion of the farmers were found to be wholesalers by themselves selling it directly to the retailers. Farmers have their own stall in Pokhara Wholesale Market where they sell their products as a wholesaler to retailers in the very wholesale price.

In addition, it was found that about 26.53 percent tomato passes to consumers through the second channel, while 8.18 percent and 10.20 percent tomato passes through third and fourth channel respectively. Only 6.52 percent of small farmers used the channel five, where farmers were growing tomato in small space and sell direct to costumers where there was no easy access to market.

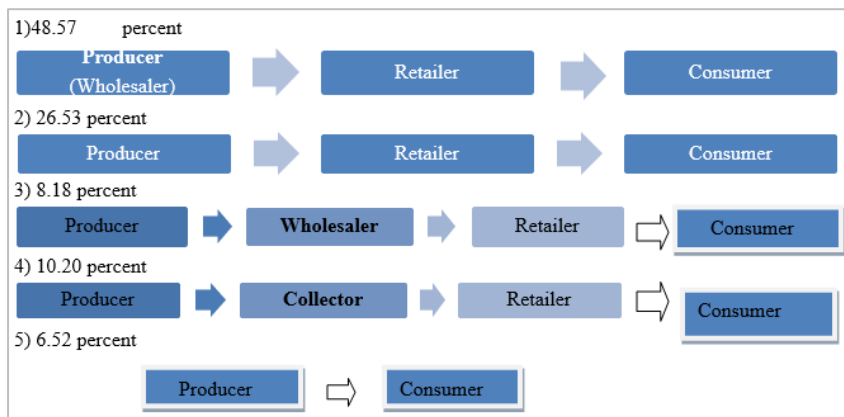


Figure 6: Marketing Channels mostly used by the tomato farmers.

3.8 Price Spread and Producers Share

Table 5: Price spread and Producers share in different Marketing channels			
No.	Chain	Price spread	Producers share percent
1	P-W-R-C	50.07	60.98
2	P-R-C	37	69.17
3	P(W)-R-C	18.10	81.89

This study found highest price spread in channel 1 with NRs. 50.07 as mentioned in Table 5, where the products move through producer to wholesaler and retailer finally to the consumer. Whereas the least price spread in marketing channel 3 with NRs. 18.10 where producers are wholesalers and price spread with NRs.37 is found in channel 2 where producers sell their products to retailers and retailers to consumers.

Producer’s share is the percentage share of producer on consumer rupee. Producer share give an indication of efficiency of existing marketing system. Higher producer share on retail price ensures efficiency of

marketing system (Sciences, 2011). Keeping this concept in mind, producers’ share was worked out in this study. The producers’ share was found to be highest in channel 3, farmers are themselves a wholesaler and sell their products to retailers in wholesale price. Farmers selling their tomato through this channel were more satisfied and happy than any other producers selling through other marketing channels. Least producers share with 60.98percent was found in channel 1, (Paudel and Adhikari, 2018) also found producers share of 60.00 percent and 61.11 percent in tomato production system off season (open field) and off season (poly house) respectively. Producers share is 100 percent in channel 5, Producers share is high where there are no brokers in between producers

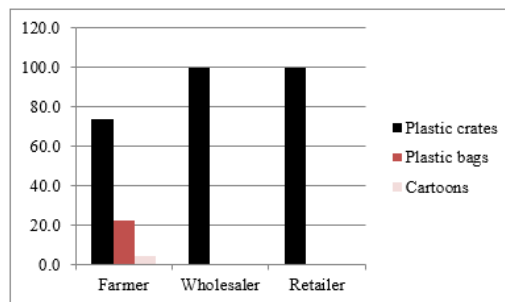
and consumers or where there is less price spread.

3.9 Packaging and Grading/Sorting

3.9.1 Packaging

Effective tomato packaging is crucial for preserving its quality. Almost all survey participants utilized plastic crates as their preferred packaging method. In particular, 73.5percent percent of farmers opted for plastic

crates when transporting tomatoes. However, it is noteworthy that packaging methods like Plastic bags, Cartoons are still in use by producers. Despite the higher cost associated with plastic crates, our findings indicated that all traders, including wholesalers and retailers, favored them for packaging (as shown in Figure 7).Plastic crates are widely utilized as a common packaging materials in many developing nations (Paltrinieri, 2017). Preference of plastic crates' is due to its ability to minimize losses during various handling stages. These conclusions align with (Bhattarai, 2018).



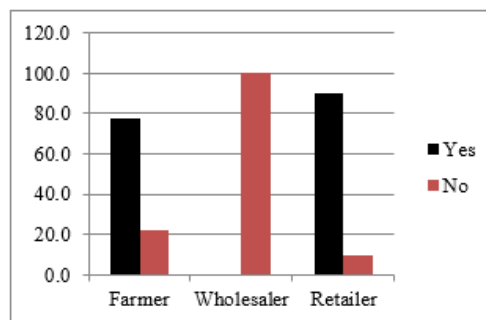
Source: Survey2023

Figure 7: Response towards packaging

3.9.2 Grading/Sorting

Grading/sorting of tomato is considered very important as it can fetch higher price to the grower. Grading also improves packaging, handling and other post harvest operations. It saves time and energy in different processing operations and reduces the handling losses during the transportation. Normally tomatoes are graded manually in the country. But different machineries are invented in developed countries. Stephenson developed an electronic detection and high-speed rotary gate

controls for sorting machine of harvested tomatoes (Londhe et al., 2013).Through the survey it was found that in Pokhara Wholesale Market that tomato is sold in two sizes- big and small. Thus, most of the farmers sort their tomato based on size and grade based on maturity stage and insect/disease attack.77.6 percent of farmers grade/sort their tomatoes while wholesaler don't grade any, while 90 percent of retailers grade tomatoes before selling. These results are in line where the authors talked about the majority of farmers sorting out their tomatoes according to the the presence of diseases and size (Khatun and Rahman, 2022).



Source: Field survey(2023)

Figure 8: Response towards grading

3.10 Constraints on Tomato Production and Marketing

3.10.1 Production Problems

In the research area, vegetable cultivators have encountered various

challenges when it comes to vegetable production, with a specific focus on tomatoes. A detailed list of these production obstacles is provided in Table 6. It is clearly depicted that farmers were constrained by climate change, Pest and disease attack, Lack of fertilizers and Lack of effective training with first, second, third and fourth rank respectively.

Problems	Index	Rank
Lack of quality seed	0.31	VII
Lack of technical know how	0.35	V
Lack of extension service	0.34	VI
Pest and disease attack	0.74	II
Climate change	0.87	I
Lack of effective training	0.51	IV
Lack of fertilizers	0.59	III

Note: Respondents were asked to rank the problems ranging from the most serious problem to the least serious problem.

It is obvious to have climate change as a major problem nowadays and it has adverse impact on vegetable production most especially to the most sensitive crop like tomato. Week of sunny days and sudden continuous rainfall have caused growth cracks, induced pest attack and diseases resulting destruction of tomato plant. In most of the research area *Tuta absoluta* and *Bemisia tabaci* were found to be major insects, while other insects like aphids, tomato fruitworm were also present.

farmers were unable to use Potassium due to its unavailability. Most of the commercial farmers were not satisfied with the training and were striving to gain more knowledge about modern technology and practices. Srijana F1 Hybrid and Amita variety were grown generally and farmers ranked low quality seed as a least serious problem in tomato production. Some researcher on their review on major constraints during off seasonal tomato production in Nepal mentioned climate change as constraint along with unavailability of quality input and skilled labour (Chaulagai and Koirala, 2021).

There was also a problem of unavailability of fertilizers. Vast majority of

3.10.2 Marketing Problems

Producers of tomatoes in the study region have encountered various challenges associated with the marketing and distribution of their tomato produce. The utmost problem faced was Lack of market information and price fluctuation. Price gets fluctuated every single day, sometimes price touch its peak which turns out to be profitable for the producers and sometimes there is sudden drop in price. Lack of Government incentives is ranked second in major constraints, all of the farmers wanted government to stop the import of tomato from our neighboring country

India, low fluctuation in prices, production of chemical fertilizers and pesticides in our own nation, easy flow of market information within the farmers and many more which is only possible through innovative of government to make it easy for tomato production and marketing. Lack of storage facilities was the least problematic issue mentioned by farmers because they directly sold tomato on same day of harvest. A group researchers also mentioned all these problems in their off seasonal tomato production: a case study of Pokhara, Kaski, Nepal (Rajkarnikar and Shrestha, 2021).

Table 7: Ranking of Marketing Constraints

Marketing problems	Index	Rank
Price fluctuation	0.82	I
Lack of storage facility	0.29	V
Lack of Market information	0.82	I
Low price	0.30	IV
High Margin	0.42	III
Lack of Government incentives	0.74	II

Note: Respondents were asked to rank the problems ranging from the most serious problem to the least serious problem.

4. CONCLUSION

Tomato cultivation is one of the profitable enterprises, that is also supported by its high benefit cost ratio. Tomato producers as wholesalers by themselves got higher net receipt from selling the products directly to retailers. Thus that would be beneficial marketing channel for farmers. Subsidy reception and total land cultivated were significantly contributing factors for economic viability of the tomato production. Among different problem regarding production and marketing of tomato, climate change, disease and insect pest was major production problem whereas price fluctuation in market price were the major marketing problems. Farmers should have prior knowledge on production cost, marketing mechanism, and the plant protection to get maximum profit from unit area. With high profit and B/C ratio tomato farming can be recommended for the farmers of the study area.

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